“I’m Diggin’ It!” Soil Outreach

Bicentennial Nature Center Network

Upper Elementary Curriculum; 45 mins- 1 hour program
Written By: Mary Jones, Cope Environmental Center

Recommended Grades: Upper Elementary (4th-5th); can be adapted to other grade levels

Indiana Standards Covered:

Geography:

- ***4.3.5*** - Explain how glaciers shaped Indiana’s landscape and environment.
- ***4.3.6*** - Describe Indiana’s landforms (lithosphere*), water features (hydrosphere*), and plants and animals (biosphere*).
  * lithosphere: the soil and rock that form Earth’s surface
  * hydrosphere: all the water on Earth’s surface, including the hydrologic cycle (precipitation, evaporation, and condensation)
  * biosphere: all plants and animals

Science:

- ***4.2.1*** - Demonstrate and describe how smaller rocks come from the breakage and weathering of larger rocks in a process that occurs over a long period of time.
- ***4.2.2*** - Describe how wind, water and glacial ice shape and reshape earth’s land surface by eroding rock and soil in some areas and depositing them in other areas in a process that occurs over a long period of time.
- ***4.2.4*** - Investigate earth materials that serve as natural resources and gather data to determine which ones are limited by supply.
- ***4.2.5*** - Describe methods that humans currently use to extend the use of natural resources.
- ***4.2.6*** - Describe ways in which humans have changed the natural environment. Explain if these changes have been detrimental or beneficial.
- ***5.3.1*** - Observe and classify common Indiana organisms as producers, consumers, decomposers, predator and prey based on their relationships and interactions with other organisms in their ecosystem.
- ***5.3.2*** - Investigate the action of different decomposers and compare their role in an ecosystem with that of producers and consumers.

Purpose:

For students to appreciate the complexity of soil, understand how long it takes soil to form, and recognize the importance of soil conservation using the Children of Indiana Nature Park as a tool.

Overview:

After distinguishing between dirt and soil, students will dive into the microcosm of the soil as an ecosystem and point of intersection for the hydrosphere, lithosphere, and biosphere. Students will then learn about the deep history of their local soils through exploration of the soil horizons and the effects of glaciation. Finally, students will see first-hand how wind and water cause soil erosion, discuss why soil needs to be conserved, and brainstorm methods of soil protection.

Outcomes:

Students will:

1. Realize the complex ecosystem of the soil.
2. Understand the long processes of soil formation.
3. Explain how humans can protect soil from erosion.
4. Articulate why Indiana soils are important to conserve.

Vocabulary Words[1]:

- ***Soil*:** The collective term for the natural bodies of earthly material that cover much of the Earth's surface; a complex combination of mineral and organic material.
- ***Hydrosphere***: All the water on Earth's surface, including the hydrologic cycle: precipitation, evaporation, and condensation.
- ***Lithosphere***: All rock on Earth's surface.
- ***Biosphere***: All life on Earth's surface.
- ***Ecosystem***: Short for ecological system, an eco-system includes all living organisms in a specific area and how they interact with one another. (Adapted from geography4kids.com)
- ***Food Chain***: A series of plant or animal species in a community, each of which is related to the next as a source of food; also called a food web.
- ***Producers***: Organisms that produce their own food, usually through photosynthesis. They are at the beginning of any food chain that starts with the sun. (Adapted from geography4kids.com)

[1] *Taken from Dig In! Hands-On Soil Investigations by National Science Teachers Association, Indiana State Standards, and other sources as noted.*

- ***Consumers***: Organisms that must eat other organisms (whether producer or consumer) to gain energy.
- ***Decomposers***: Organisms that break down nutrients in dead material and return nutrients to the soil such as bacteria and fungi. (geography4kids.com)
- ***Parent Material***: Solid rock that underlies the soil; also called bedrock.
- ***Topsoil***: The upper, outermost layer of soil, usually the top 2-8 inches. It has the highest concentration of organic matter and microorganisms and is where most of Earth's biological activity occurs.
- ***Subsoil***: The layer of soil found between the topsoil and parent material that may contain sand, silt, and clay but is devoid of organic materials found at the surface.
- ***Glacier***: A dense body of ice on that is constantly moving (or flowing) due to its weight.
- ***Soil Erosion***: Soil erosion occurs when soil is removed through the action of wind and water at a greater rate than it is formed. (National Department of Agriculture)

Materials Needed:

Drawing the Soil and Spheres of Influence:

- Giant paper or Post-It pad
- Easel
- Thick markers (black, brown, blue, green, and red)

Measuring Soil's Source:

- Step stool
- Measuring tape with paper grass on the end, a black dot at 80" and a blue dot at 8"
- Mason jars with topsoil, subsoil 1 (loamy) and subsoil 2 (gravelly sand)
- Slab of limestone (or appropriate parent material)

An Edible History of Soil:

- Saltine crackers (enough for every child to have one)
- Bucket(s) to collect waste

Blown Away:

- Three aluminum cake pans representing three different soil conditions
    - "Plowed Field": filled with soil
    - "Crop Residue": filled with soil and grass strewn on top
    - "Meadow": soil with firmly rooted grass
- 3 clear trash bags (one marked for each of the above)
- Hair dryer
- Extension cord, if needed

Soil: The Apple of Our Eye:

- Apple
- Knife
- Cutting board, if needed

The Program

Welcome/Introduction (10 Minutes):

*****Interpretation Note: Many parts of this document are written as speech and will appear in a grey box. Please feel free to adapt and change as necessary. It may be helpful to write out exactly what you want to say (at least in the introduction), but this document is really an outline, not a script.**

Introduce yourself, your organization, and the topic of the day: soil!

(The following wording is the SAME wording as featured in the field trip program. PLEASE ADAPT THIS BASED ON THEIR KNOWLEDGE OF THE CHILDREN'S PARK PROJECT. This should be used the FIRST TIME the children are introduced to the project. If this outreach is performed AFTER the field trip, simply remind the students of the gift and ask if they have their deeds! You might even "autograph" the deeds for them as an important person in their environmental education journey!)

Did you know that YOU have been chosen to receive a special gift? Let me ask you something. What do you think of when you hear the word "park"? Slides? Swings? Playgrounds? Well, we have a NEW way to think about a park. When you hear that word, we want you to think of trees, birds, insects, and presents. Wait, presents?! Yes, presents. The State of Indiana has decided to give you a gift, but it's not one that you unwrap, it's one that you protect, just like a special birthday gift. Indiana created The Children of Indiana Nature Park in Centerville, Indiana in honor of you. It doesn't have swings or slides; instead, it has trees, trails, tracks, and turtles. Indiana thinks you are so important, that each one of you can claim a "deed" for a piece of this land. What's a deed? It means that you are in charge of protecting something special. Your teacher is going to help you claim your deed, and you can learn about your piece of land and all of the ways it is growing and changing by visiting a special website listed on your deed. But how can we protect this land or the land that we live on without learning why it is important? Well, we are going to start today! Today's program is called "I'm Diggin' It!". Once I leave today, you will know why!

Dirt vs. Soil (5 minutes):

*Now, before we get started, I want to make one thing clear: **soil** is NOT dirt! Everyone take a look at your shoes. If you've been playing outside, you probably have what I would call "dirt" on your shoes. Who thinks they have a good example of dirt to share? Call on a volunteer and have them stand by you and hold up their shoe for the class to see. Where do you walk/play, and where did the dirt come from? (The school yard, backyard, etc.) THAT is soil! Have the child sit down. So, before we move on…today we are talking about **soil** NOT what? **(DIRT!)***

Drawing the Soil (10 minutes):

*See Appendix II for full diagram of activity.

So that dirt, which we found on "Zoe's" shoes, came from SOIL somewhere. Maybe it was her backyard or the school yard or the park. Up here I have a very basic picture of soil- let's say it's from a backyard. How many of you have ever dug in the yard? If you have, you know that there are a lot of things missing from this picture. Raising your hand, who can tell me something that's missing?

Call on a student. Let them draw their idea on the paper with the black marker. Help the students think of different things from each different sphere as they continue to add to the diagram.

Possible examples for each sphere:

- Lithosphere: rocks, pebbles, fossils
- Hydrosphere: water from rain
- Biosphere: roots, seeds, spiders, worms, ants, small mammals (moles), something rotting/decomposing (banana peel, apple core), mushrooms

Spheres of Influence (5 minutes):

*See Appendix II for full diagram of activity

Now let's group some of the things that are going on in this soil. First, let's group all the rocks. Circle or color in all rocks and pebbles in brown. Let's call this the ***lithosphere.***

Write lithosphere in brown at the top of the page. Have them repeat "lithosphere" making a motion like their holding a rock.

Now let's circle any water (use blue). Let's call this the ***hydrosphere*** *(make a motion like a river flowing).*

Finally, let's circle all the living things (use green- have the kids help find them all). We'll call this the ***biosphere*** *(make a motion like something growing). Now in the biosphere there's even more going on. Right now we have an ant and a spider. How do they relate to one another? Are they friends or is one food for the other? What else do we have drawn that's food for something else?*

Draw arrows between organisms to show the food chain in red. For example: seed → ant→ spider→ small mammal.

*What do we call this? **(Food chain!)** Who's at the top of this chain? What happens when they die? Talk about **producers (plants)** vs. **consumers (animal)** vs. **decomposers** in the context of the soil.*

*As you can see soil is WAY more interesting than dirt. It has many kinds of living things and gives them food, water, and shelter. That means soil isn't dirt, it's a teeny tiny **ecosystem**!*

Soil is a very important part of the Children of Indiana Nature Park. Your piece of land, even if it's a spot right in the middle of a trail, has a whole world underneath it supported by soil. If we don't take care of the soil, what could happen? Could trees grow on your land? Would critters survive? Let's learn more about soil so that we can be great caretakers of the land in Indiana.

Besides various forms of life, soil also has water and rock. In fact, the soil is the ONLY place on earth where these three spheres (biosphere, hydrosphere, and lithosphere) all come together in the same place!

Measuring Soil's Source (5 minutes):

*So where does that soil come from? What we just drew was the **topsoil**. (Show mason jar of top soil.) Topsoil is the stuff at the very surface. Because the topsoil is so close to the living things in the biosphere, it is rich in nutrients from decaying plants and animals. But this soil began as something quite different. To find out where soil starts forming we have to go much deeper! To show you just how deep, I need two more volunteers.*

Have one volunteer stand and hold the measuring tape. Have paper grass glued on the tip of measuring tape to show that it is ground-level. The other volunteer must pull down on the tape until the black dot is visible to the audience (marked at 80 inches). Make sure your step stool is in easy reach for them to use…they'll need it!

*If you dug down about this deep (actually even a bit deeper!) in East Central Indiana, you will hit bed rock or the **parent material** of the soil. Show a slab of limestone. The parent in this part of the state is mainly limestone and shale. It's called the "parent material" because it is the base of our soil. So at the surface we have the rich topsoil and far down we have where it came from- the parent material.*

Draw attention to the blue dot, marked at 8" that represents the end of the topsoil.

*Between the two, we have a mixture of both called the **subsoil**. Instead of being fine like the topsoil, the subsoil is rockier and has bigger chunks of the parent material. The closer the subsoil*

is to the topsoil, the more it looks like topsoil. The closer it is to the parent material, the more it looks like the parent material.

Show mason jars with two subsoil examples, one close to the top and one close to the bottom. Thank the volunteers and have them sit down.

An Edible History of Soil (10 minutes):

*To show you how **THIS** (hold up the limestone slab) turns into **THIS** (hold up the topsoil jar), I have something I want to give to everyone.*

Pass out one saltine to every child. If there is a big group, call on volunteers to help pass them out. Tell the kids to hold it carefully, and not to eat it! Wait until everyone has a saltine.

*Right now everyone has a saltine cracker. This cracker represents the **parent material** of a soil, almost like our slab of limestone. Now over time, a LONG time, hundreds of years, something is happening to our parent material. Even though it is very far down, whenever it rains, water trickles down over it. If the water freezes, it can crack some of the rock.*

(Have the kids break their cracker once.) Pressure can also crack the rock.

(Have the kids crack their cracker again.) This happens over and over.

(Have the kids crack their cracker one more time.) After a LONG time, again, thousands of years, some of the bedrock has broken apart and moved into the subsoil.

*(Hold up the gravel subsoil jar.) This process of breaking from pressure and water continues in the **subsoil**.*

(Have the kids gently crush their small pieces. Make a comparison to the loam subsoil jar.) As the rock moves upwards as it gets smaller, it is also broken down from living things like the roots of plants.

*(Have the kids pulverize what is left of their cracker. Have them open their hand gently to observe. Afterwards, have them hold their hand closed and keep it closed.) Eventually, what was once part of a massive rock has become tiny rock particles closer to the surface. Here, they meet matter from decomposing plants and form the rich **topsoil**.*

Glaciers (5 min):

How long do you think it takes to form 1 inch of topsoil, knowing all that has to happen? ***500-1000 years!***[2] *Now wait, let's get out our measuring tape. According to this, we have about 8 inches of rich top soil and we would have to go down over 80 inches to hit parent material! That's A LOT of good soil! In other parts of the country, for example, out west, you would be lucky to have a couple of inches of topsoil and, if you dug down, you would hit solid rock way before 80 inches. The reason Indiana has so much good soil is that the soil around here took a shortcut when it was formed. Around 21,000 years ago, there was ice over about half of Indiana! In fact, it was a huge* ***glacier****, like the ice caps on the north and south poles with ice a MILE thick!*[3] *In fact, the glaciers of the last major ice age crept to about Brookville, IN just south of your special piece of Children's Park land. That ice acted like a big bulldozer. As it moved south during the ice age, it scraped the earth, grinding everything it picked up. This sped of the process of turning big pieces of rock into soil. When the glaciers melted at the end of the ice age, they left behind a lot of the ground up debris they were carrying, giving us lots of rich soil!*

Blown Away (5 min):[4]

Even though Indiana had the glaciers as a short-cut, it still took a VERY LONG time to form our soils. Unfortunately, it takes much less time to lose our soil if we don't take care of it. How do you think we could lose our soil? (Take responses.) The biggest factors are wind blowing soil away and water washing it away. Unprotected soils are especially at risk for being lost quickly. We call this ***soil erosion*** *when soils are being lost faster than new soil can form to replace it. Let me show you.*

Here I have soil as you might see when driving in Indiana. Show cake pan with loose soil. This represents a plowed field with just soil. It has no protection. Show cake pan with loose soil and grass sprinkled on top. This represents a plowed field with some crop residue left. How many of you have ever driven by a corn field in the fall and seen the dried stalks from the summer's crops? Soil like this has some protection. Show cake pan with grass. And this represents a meadow. It has a lot of protection.

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[2] "How Long Does It Take for Soils to Form?" Soil Matters, Get the Scoop! August 29, 2013. Accessed February 16, 2015. https://soilsmatter.wordpress.com/2013/08/29/soil-formation.

[3] "Wisconsin Glaciation." Wikipedia. October 24, 2014. Accessed February 16, 2015. http://en.wikipedia.org/wiki/Wisconsin_glaciation.

[4] adapted from Dig In!: Hands-On Soil Investigations by National Science Teacher Association

Choose two volunteers. Have one hold the pan at an angle (representing a field with some slope) and the other hold the clear garbage bag under it. Blow the hair dryer over the "Plowed Field" for 30 seconds. The kids can help you count. Switch bags and repeat for the "Crop Residue" and "Meadow". Hold up the clear trash bags for the students to compare how much was lost in each.

So which pan had the most erosion? Why? What did that pan represent? Which pan had the least erosion? Why? What did that represent? After this experiment, how can we help keep our precious top soil? (Plant trees, make sure soil has plant cover, etc)

Soil: The Apple of Our Eye (Remaining time minus 5 min.): [5]

So we've talked about how soils are like mini-ecosystems, how they form, and how they get eroded away, but why is soil important? Who has an idea? (Get some ideas from raised hands.) I'm thinking of something we need to do every day, something we should do three times a day…FOOD! Who can tell me what you had for breakfast/lunch today? (Explain how all food, even processed food like Pop-Tarts, comes from plants or animals that depend on the soil.) A lot of the food we eat comes from crops like corn and wheat, which can only grow on certain soils. Although the earth is a big place, there are only a few places on it, like Indiana, that can grow crops well. (Take out your apple.)

1. Tell the kids to imagine the planet Earth as an apple. The skin of the apple is the crust of the earth. The core of the apple is the core of the earth.
2. Ask the kids if they know how much of the planet is land. Cut the apple into fourths; only ¼ of the earth is land. Set aside the rest.
3. Cut the land section in half. Half of the land on Earth contains mountains, deserts, or covered in ice and is not livable. Set this aside.
4. Cut the section representing habitable earth into fourths. Set aside three. They represent areas that are too rocky, infertile, hot, or urban to grow food.
5. All that is left is 1/32 of the apple. Carefully remove the skin.
6. The skin represents all the soil (crust of the earth) that we have to feed all the world's people! ***Did you know that we have over 7 billion people to feed in this world? What would happen if we didn't take care of Indiana's soil? We produce LOTS of food for the world. They are counting on us to be responsible!*

[5] Taken from *Dig In!: Hands-On Soil Investigations* by National Science Teacher Association

7. Cut the skin in half. In the last 150 years, ½ of the topsoil on the planet has been lost[6].

*Full original activity in Appendix III. Step 7 has been added.

Because there is so little soil on our planet that is fertile for growing food for everyone, it is important that those of us who are lucky to live on that soil to know how to take care of it!

Closing (5 mins):

Thank you for letting me come in today and talk about soil! Ask review questions.

- *Who can name something that lives in the soil's ecosystem?*
- *What does a decomposer do?*
- *What do we call the materials where soils come from?*
- *How long does it take for 1 inch of soil to form?*
- *Why do we have such rich soil in this part of Indiana?*
- *What is one way soil can erode?*
- *What can we do to help protect our soils?*
- *Why are soils important?*

Isn't it cool that your special piece of land at the Children's Park is located in Indiana where we have such incredible soil? It's you turn to help us take care of Indiana's special land. Think of some things you can do to protect your own backyard and the soil near you (We talked about lots of ideas today such as planting trees!). You'll be a conservation hero!

[6] "Soil Erosion & Degradation." World Wide Fund for Nature. Accessed February 16, 2015. http://www.worldwildlife.org/threats/soil-erosion-and-degradation.

APPENDIX I

Customizing the Curriculum

To find out more about your local soils, you can create a map specifically to your region using Web Soil Survey from United States Department of Agriculture (USDA). Directions to use the tool and the access link can be found here: http://websoilsurvey.nrcs.usda.gov/app/

I used this site to identify a specific soil found on Cope Environmental Center's property in "Measuring Soil's Source". Soil horizon lengths in the program as is are based on Miami, Gravelly Substratum. Description below.

Description of Miami, Gravelly Substratum

Setting

- *Landform:* Moraines, till plains, outwash plains, stream terraces
- *Landform position (two-dimensional):* Backslope, shoulder
- *Landform position (three-dimensional):* Side slope
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Parent material:* Loess over loamy till over sandy and gravelly outwash

Typical profile

- *A - 0 to 8 inches:* silt loam
- *B - 8 to 36 inches:* clay loam
- *C1 - 36 to 60 inches:* loam
- *2C2 - 60 to 80 inches:* stratified coarse sand to very gravelly sand

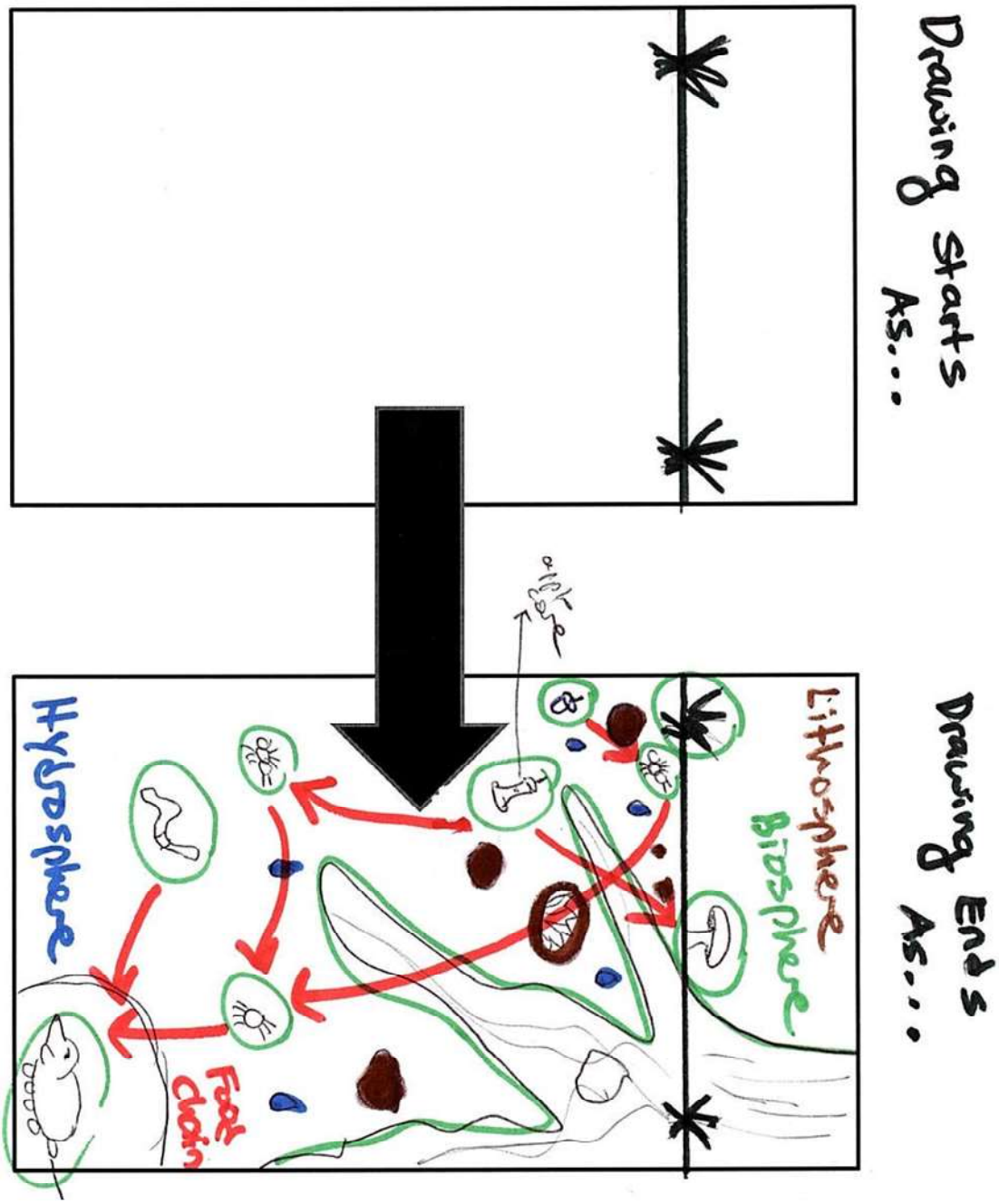
To find the bedrock specific to your region (needed for "Measuring Soil's Source" and "An Edible History of Soil") visit http://igs.indiana.edu/Bedrock/.

To learn more about the extent of the glaciers and how they may have affected your region, check out http://igs.indiana.edu/Surficial/IndBoundries.cfm

More Indiana specific resources on soil can be found here: http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/in/soils/?cid=nrcs144p2_031079

APPENDIX II

Diagram for "Drawing the Soil" and "Spheres of Influence"



APPENDIX III

Diagram for "Apple of my Eye"

Figure 5.1. Only a small portion of land is capable of producing food.

1 Imagine the Earth as an apple.

2 Cut it into fourths. Only one part is land—the rest is water. Set aside the three sections that represent water.

3 Cut the land section in half. One part represents land that is mountains, deserts, or covered with ice. Set this part aside.

4 Cut the other livable area into fourths. Three of these are too rocky, wet, hot, infertile, or covered with roads and cities to grow food. Set these three aside.

5 There is now only 1/32 of a slice of apple remaining. Peel the skin from this tiny piece.

6 The skin represents the soil on which the food is grown that must feed all the people on Earth.

REFERENCES

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"Another Link in the Food Chain." Geography 4 Kids. January 1, 2015. Accessed February 16, 2015. http://www.geography4kids.com/files/land_foodchain.html.

III*: Other Resources for Users*

http://www.soils4teachers.org/lessons-and-activities